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Sustainability, space and supply chains: the role of bamboo in Anji County, China

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Abstract

Rural modernization in China has been profound as the countryside has moved from agricultural production to industrial and tertiary industry development. Within rural areas these changes can have enormous significance for how we think about their sustainability. One rural county that vividly illustrates both the challenges and opportunities of rural development is Anji in Zhejiang Province in Eastern China. Anji is held up as a model of rural sustainable development. In this paper we analyse the basis for the sustainability claims made of Anji and to do so, we examine how the production and processing of bamboo materials transformed Anji into a place-specific bamboo-making locality that is lauded for its sustainability. We analyse how thinking on a place and a material (bamboo) come together to reinforce thinking on sustainability in rural China. We then go on to critically question the politico-economic arrangements that construct Anji and bamboo as models of sustainability. We argue that whilst both Anji and bamboo do have notable features that characterise them as sustainable and together can make an even more persuasive case for rural sustainability, a more detailed analysis allows us to uncover the deep-rooted tensions that persist in Chinese rural development between environmental protection and economic growth. The paper draws on a mixture of published and unpublished material to provide a detailed examination of the ways in which bamboo supply chains operate within and through Anji. The paper concludes that local constructions of sustainability are driven by economic rather than environmental values.

Key words: rural sustainability, Anji, China, bamboo, sustainable places, sustainable materials

1. Introduction

Research on the transformation of China during the past 30 years includes documentation on both the quantitative and qualitative changes brought about by urbanization and industrialization. These changes not only transform the population structure, land use patterns, cultures and living standards (Long et al., 2012 and Long, 2014), but also produce spatial disparities in both rural and urban settings (Goodman, 1994; Smart and Lin, 2007). Whilst understandably much attention has been given to urbanisation (Siciliano 2012; Wu and You 2012; Wu et al 2013), rural modernization has been profound as it has moved from agricultural production to industrialization and tertiary industry development. Within rural areas these changes can have enormous significance for how we think about their sustainability. One rural county that vividly illustrates both the challenges and opportunities of rural development is Anji in Zhejiang Province in Eastern China. Under the programme of 'building a new socialist countryside policy', Anji is constructed as a success story, a winner of multiple awards including National Ecological County, China National Habitat Environment Award and UN-Habitat Scroll of Honour because of its bamboo production and processing, and eco-tourism. Anji is held up as a model of rural sustainable development (Marsden et al., 2011) but how does a county gain such status? How does the growing and processing of bamboo come to be regarded as sustainable? And how does the material (bamboo) and the place (Anji) become so inextricably linked together that they mutually reinforce ideals of rural sustainability?

To answer these questions, we make an important contribution to the literature on rural sustainability by developing a critically informed place-based development model that shows the intertwining of a local material and people. The material, in this case bamboo, produces economic and environmental value and helps to shape the way in which Anji is constructed. We document how since the 1980s the creation of a sustainable place and a sustainable material have

been occurring and how the two have become ever more closely connected. Despite the apparent appearance of sustainability for both the place and the material, there remain inherent tensions between the economy and the environment. Whilst the model draws upon our research in Anji County (see Figure 1) it has much wider relevance to rural Eastern China where resource dependence and development pressures are most obvious and may prove to be equally intractable.

Figure 1 Map of South East China showing location of Anji County



Anji can be found in the north of Zhejiang Province. It is one of three counties under the jurisdiction of Huzhou Municipal Government. It is located in the economically dynamic and politically important Yangtze River Delta. Anji covers an area of 1886km² with population of 450,000. Anji has a high quality ecological environment, for instance, 75% of the county is covered by forest. The green nature of the county mean that Anji is widely regarded as an 'ecological green oxygen bar' within the Yangtze River Delta region.

Anji has a large reserve of Moso bamboo¹ (approximately 135 million stands, with an average of 2,670 stands per hectare). In many ways, bamboo has the features of a classic sustainable material: it is natural, grows rapidly and can do so with limited or no inputs, can be substituted for more environmentally damaging materials (such as plastics, fibres or woods) and can have limited waste. In addition, as a natural material, bamboo is biodegradable. Whilst these are features that can be attributed to bamboo they may not necessarily hold true in local contexts. Moreover, bamboo can, like other materials, be the subject of scarcity which can promote ever more intensive production. In other words, the sustainability of a material can be both time and place specific.

In the paper, we analyse how the production and processing of bamboo materials transformed Anji into a place-specific bamboo-making locality that is lauded for its sustainability. We analyse how thinking on place and a material (bamboo) come together to reinforce thinking on sustainability in rural China. We then go on to critically question the politico-economic arrangements that construct Anji and bamboo as models of sustainability. We argue that whilst both Anji and bamboo do have notable features that characterise them as sustainable and together can make an even more persuasive case for rural sustainability, a more detailed analysis allows us to uncover the deep-rooted tensions that persist

¹ There are 179 species of monopodia bamboos, which account for 71.6% of the total number of monopodia species in the world. Moso bamboo is a temperate species of large bamboo. It is typical of the bamboo grown in Anji. In the rest of the paper we refer to bamboo and it will nearly always be Moso bamboo.

in Chinese rural development between environmental protection and economic growth.

The paper is divided into 4 further sections. In Section 2 below we develop our argument as to how a material and a place become so closely intertwined that they can co-construct a model of sustainability. We do this by bringing together three perspectives: first that of environmental governance to highlight how the local state has opportunities to shape spaces; second that on bamboo to show it can be fixed to a space (in this case Anji) and also flow through spaces (as part of a supply chain); and third how place making and meaning are constructed, focussing particularly on Anji. In the following section, Section 3, we outline our data collection approach. In Section 4 we provide a detailed analysis of the development of the bamboo industry and how it contributes to a local model of sustainable development. In this Section we also highlight the fragility of the system, notably how Anji seeks to secure external bamboo supplies when its own are insufficient. Finally, in Section 5 the paper concludes by arguing that more attention needs to be given to local level analysis of rural sustainability.

2. Places and materials: making connections between bamboo and Anji

In this Section, we bring together three different approaches to critically analyse how a model of sustainable development can be developed for Anji. First, we outline why debates on environmental governance matter for the way in which decentralisation can create opportunities for a local state to promote a distinctive developmental model. New forms of environmental governance also create opportunities for materials that can be identified as sustainable. As we show in the following sub-section a material and a place can also be linked together to reinforce their sustainability claims. In the final part of this Section we bring together ideas on place making and meaning to show how they operate in Anji.

2.1 The governance of eco-development

Even before the transition from a command and control economy to a more market oriented one launched by Deng Xiaoping in 1979, there had been concerns about pollution and over use of resources. Economic liberalisation has hastened the growth in Chinese industrial output and the consumption of its citizens and is placing enormous demands upon the environment (Day 2005; Shi and Zhang 2006). Increasing recognition of the social, economic and environmental costs of development has led to government statements which have confirmed the importance of sustainability, a raft of new laws, and greater regulatory pressures upon the larger, private companies (Shi and Zhang 2006). Whether these initiatives are sufficient to promote a new form of environmental governance is a key question and one to which scholars, such as Mol (2006) and Beeson (2001), have been turning their attention. So far, the debate on environmental governance has largely been concerned with seeking to understand the nature of the environmental state, its capacity for action, and the extent of the institutionalisation of environmental policy within the state apparatus and major private companies (see Xue et al 2007, Ma and Ortolano 2000). Much less attention has been given to the way in which environmental governance is played out in urban and rural development.

To understand the nature of urban and rural eco-development we first draw upon the literature on environmental governance in China. Although this literature contains a number of useful insights it rarely considers that there might be distinctive rural and urban patterns of governance, and that this will be significant for eco-developments. Moreover, the burgeoning literature on urban governance, and the much more limited literature on rural governance, underplay how the environment and the environmental agenda might be helping to shape development in China.

In any understanding of environmental governance, or the so-called 'environmental state' (Mol 2006; Johnson 2009), in China there are at least four themes that need to be considered. These are decentralisation, administrative capacity, authority, and civil society. Within this perspective, wider issues relating to the institutionalisation of market dynamics are ignored though this is not to say that they are unimportant. Our argument here is twofold. First, that situating actors within an institutional framework is essential for understanding the eco-development process. Second, as central state authority is modified, there is an increasing unevenness in sub-national governance arrangements: different actors, sets of interests and arguments move to the fore (Mol 2006, p31), and this provides opportunities for entrepreneurial local governments to promote distinctive approaches to development.

Decentralisation

Bureaucratic reforms since the late 1970s have had the effect of pushing both decision-making discretion and financial responsibility downward, shifting power from national ministries to lower tiers of government (Mol, 2006; Lo et al 2001; Shi and Zhang, 2006; Xie and Van Der Heijden 2010). Environmental governance has shared in these broader trends towards greater decentralisation and flexibility. Whilst decentralisation may result in policies and practices that are better suited to local environmental conditions, and which may diverge substantially from national policies, it may simply make it easier for local elites to marginalise environmental management issues. Decentralisation with its encouragement of local initiatives may even hasten 'capture' by national government of local ideas and their promotion elsewhere. For instance, central government has sought to encourage particular development models through the recognition of Anji as a National Ecological County. The award distinguishes Anji from potential competitors and brings with it rewards, such as national government support for capacity building in the local bamboo industry.

Administrative capacity

The national system of environmental regulation is implemented through the different levels of government – national, provincial, municipal and county (Mol, 2006). It is at the provincial, municipal and county levels where much of the business of environmental management takes place and the different tiers of government are responsible for funding their environmental protection bodies. In one of the rare studies of the workings of these bodies Lo et al (2001, p55) have found that where there is the possibility for external fund generation “[m]ost service organizations have become increasingly enthusiastic in revenue generation which has led to goal displacement. From their standpoint, the profit-making activities undoubtedly take precedence over the more mundane business of public service provisions.” More generally, it is possible to argue that development ideas may make commitments to sometimes quite sophisticated notions of environmental protection but the practices of local government remain wedded to economic development.

Authority

Whilst there is a much greater rhetorical commitment to environmental protection (Xue et al 2007), including higher status accorded to environmental protection bodies and more stringent regulations, environmental bodies largely remain marginal when compared to economic and developmental interests (Mol, 2006, Zhang, 2002). In Anji, though, there are indications that environmental imperatives are, at least temporarily, able to move to the fore. For example, in Anji regulators have resisted developmental pressures and refused to approve what are perceived to be polluting activities (China Daily, 2008). Moreover, as we shall see below, the government in Anji has been active in promoting both the place and bamboo as sustainable. Government has been able to wield considerable authority through support for the bamboo industry and for a local form of sustainability (Marsden, et al 2011).

Civil society

Environmental ideas and groups are a recent development in Chinese society and are only weakly developed. In contrast to Western NGOs, Chinese groups emphasise consensus and expertise. Indeed, a number of groups have been fostered by government, so limiting their independence and ability to articulate a more challenging environmental perspective (Alpermann, 2010; Mol 2006, Xue et al 2007; China Daily 2015). Even so, citizens groups and more formal organisations can act as intermediaries between wider civil society and professional bodies, state agencies and developers to communicate environmental concerns (Mol and Sonnefield, 2000; Mol 2006; Shi and Zhang 2006). In turn, environmental organisations can help to relay to their constituencies' professional and economic development perspectives. This is important for bamboo growers who both receive messages from government on how they can grow bamboo more efficiently but also relay information on the environmental limits that they confront through increasing intensification. As we shall see, though, there is a developmental logic that continually underplays environmental impacts and gives less than whole-hearted consideration to environmental concerns.

The literature on Chinese environmental governance provides important insights into the centrality of the state to environmental management and to the unfolding process of change at the sub-national level. What is missing, though, is a detailed critical social science analysis of how the environment is incorporated into (or excluded from) eco development in rural (and urban) areas. In other words, the literature recognises that there is increasing variability in governance arrangements but does not root them in the very distinctive policy circumstances that surround local rural (and urban) development. Moreover, debates on environmental governance have tended to treat the environment at an abstract level and not linked it to the experiences of key actors (Smart and Smart, 2017). For example, there is often reporting of pollution and legislation but little

understanding of how the data or the experience of a polluted environment is received by communities or bureaucrats. Or, more specifically, for our purposes how the growing of bamboo and the processing of bamboo are experienced and interpreted at the local level and how they may contribute to claims about rural sustainability.

2.2 Bamboo: a sustainable material?

Bamboo² is one of the most multi-use natural products available. Bamboo can be used for building (scaffolding), flooring, roofing, fabrics and cloth, pulp and paper, charcoal, food (bamboo shoots), and ornamental garden planting. There is now increasing interest in the role of bamboo forests as carbon sinks as it can easily compete with most wood species in terms of its carbon sequestration capacity. Whether it is as a material use or as a carbon sink, the growing and use of bamboo inextricably links rural areas to one another and rural to urban areas. How these linkages are constructed and maintained provides valuable insights into how products are given meaning and can be linked to places. This in turn helps us to understand how local forms of sustainable development can be nurtured as well as their potential fragility. With modern processing techniques bamboo can be transformed into many products that compete directly with wood products in price and performance (bamboo products are discussed further below). Bamboo is also known to be a valuable ecological resource for soil and water conservation and restoration of degraded lands.

It is estimated that bamboo occupies over one percent of the tropical and subtropical forest area - over 22 million ha. Over 80% of the total area covered by bamboo is located in Asia, 10% in Africa and 10% in America. About 30% of

² Bamboo is an ancient grass, a woody plant. Bamboo is mostly distributed in tropical and subtropical zones between 46 North and 47 South latitude in Asia, Africa and America. The most widely known features of bamboo are its fast growth, adaptability, resilience and substantial biomass production. Bamboo is also an environmentally friendly plant and net carbon sink, producing 35% more oxygen than wood.

bamboo may be classified as forest plantations. According to the FAO/INBAR global thematic study (Lobovikov et al 2007), over 63% of bamboo resources are privately owned with 36% of bamboo resources owned by governmental entities. In comparison, 80% of all world forests are on public lands.

Over 20 million tons of bamboo are collected and utilized annually. Those in rural areas and the poor are the prime harvesters of bamboo, widely known as a 'poor man's timber'. The global bamboo trade is estimated to be between 1.5 to 2.5 billion USD. Although it occupies only 1-3% of the total tropical and sub-tropical forest area, including trees outside forest lands, bamboo contributes between 4-7% of the total tropical and subtropical timber trade.

About 1.5 billion people depend on bamboo for their daily lives. As a consequence, development specialists (such as Marsh and Smith 2007, Ruiz Perez 2004) have long recognised, that when positively managed bamboo forests and industries can act to retain a rural population since they can promote economic and environmental growth, mitigate deforestation and illegal logging, prevent soil degradation and restore degraded lands. Debates on bamboo have been dominated by those who come from a development studies or agronomy/forestry background. Given the social, economic and political significance of bamboo at both a local and global level it is somewhat surprising that the wider social science community have paid it such little critical attention (but see Tambourzatis et al 2013, Wilkes et al 2016 and Wilkes 2014 who are engaging with ideas on sustainable materials from an engineering perspective and seeking to engage with social science debates).

The traditional markets for bamboo products are handicrafts, chopsticks and bamboo shoots (food). Emergent markets, with the greatest value added, include furniture and flooring. Here there is not only a domestic demand but also significant export markets. For example, Anji is a major supplier of bamboo flooring to the Australian market. The development of multiple products using

bamboo is a relatively recent phenomenon. It is only since the early 1990s that there has been a marked increase in the variety of bamboo products on the market. Whilst traditional products - furniture, baskets, scaffolding and chopsticks - remain popular items of consumption amongst rural dwellers, there have been a number of innovations in bamboo processing that have allowed the development of new products such as flooring, laminated furniture, fabric and drinks.

Whilst the whole bamboo plant can be utilised, manufacturers and processors who work in distinctive markets, are reliant upon specialist machinery and only need to access a particular part of the bamboo (whether it be leaves, twigs, or the main part of the stem) for their product. There is, therefore, a potential for economic actors to compete for bamboo supplies, use the part that they need and the remainder becomes waste. In Anji, however, the clustering of the bamboo industry has resulted in a more co-operative and less competitive style of working in which processors and manufacturers have developed synergistic relationships so that they gain access to the part of the plant that they need (see the following section for a fuller discussion). Since the whole plant is effectively being used there are more limited amounts of waste than may be found, for example, with wood products in the area. In Anji there are well developed waste collection services and processing activities to make products, such as charcoal and fibre board which can be amongst the most profitable of all bamboo products (key person interview with waste industry in Anji). The utilisation of the complete bamboo plant and the reduction of waste to almost zero, means that bamboo has the potential to be held up as an exemplar sustainable material. In large part because of its use of bamboo Anji too has been promoted as a model of rural sustainable development (see Marsden et al 2011 for an extended discussion) and we explore further the interaction between place and products in the section below. Here though it is worth briefly noting that any notion of sustainability is fragile and needs to be continually constructed. For example, markets need to be found and maintained for such a wide variety of products so ensuring the use of the whole plant; whilst supplies need to be secured, often from increasingly

distant locations, to meet the demand from a buoyant market for bamboo products.

2.3 Place making and meaning in Anji

Work on supply chains tends to be concerned with efficiency, the length of the chain, and the adding of value (Jackson et al 2006). More recently, a richer and more nuanced perspective has emerged in which interest is paid to the way in which the meanings of products “are produced and negotiated by a range of actors at different points along the supply chain” (Jackson et al 2009, p13). Much of the interest in the meaning of products has been concerned to understand the cultural meanings of food, with an interest in particular products (such as chickens, beans, sugar) (see, for example Jackson et al 2009, Friedberg 2004). Bamboo too has a number of meanings attached to it, in part based upon the variety of products (from fabric to food) for which it is suited and in part its attachment to specific locations. As we explore below, Anji is widely recognised as the home of bamboo and able to impart a distinctive meaning to its bamboo. Recognising the way in which products and place become increasingly intertwined provides a distinctive insight into the production of meaning. An integral part of the meaning attached to bamboo as a product and Anji as a place is sustainability (see Figure 1).

According to Agnew (1987) the concept of place can be understood in three major ways: (1) location (a spot in space, physical relationship); (2) locale (an entity for social relationships); and (3) sense of place (a subjective relationship to the place). Place is an important influence in environmental politics (Kudryavtsev et al 2012 and Stedman 2003). Creswell (1996) further explains that there are different societal norms to determine certain behaviours that should be in place or out of place. What we can see is that the images of bamboo in Anji County are constructed discursively to inform societal norms of sustainability,

determining a green supply chain and the sense of a greening county. To understand interrelationships between bamboo and place-making, we would like to build upon Marsden et al's (2011) localised eco-economy model in order to conceptualise how a place-based bamboo production model is constructed and operates in response to economic needs and environmental concerns. According to Marsden et al. (2011) bamboo production and processing not only produces a cluster of production and consumption spheres but it also supports places for foods, eco-tourism, biofuel, and materials for processing. The eco-economy in Anji is driven by the County government to produce social capital, increase regional competitiveness, and improve the livelihood of local residents through bamboo production and processing. The Anji case is "a source of new interconnected and embedded ecological and economic innovation and strategic regional planning" (Marsden et al., 2011, p. 219). To further contextualise the Anji case as a source of new integrated and embedded ecological thinking, we need to examine how the local state and farmers interact with bamboo nature. In so doing, we conceptualise how bamboo and local people co-produce a place-based sustainable development model (see Figure 2 and Table 1). This place-based bamboo production model focuses on the interrelationship between historical contexts, spatial patterns of socio-environmental processes and the governance of the bamboo processing industry. Both bamboo and place are co-constructing sustainability, economic activities and material-welling for both humans and nature and in Table 1 we have outlined how key analytical themes around materiality, meaning and governance co-construct how sustainability is realised in bamboo and Anji.

Table 1 Co-construction of sustainability of bamboo and Anji

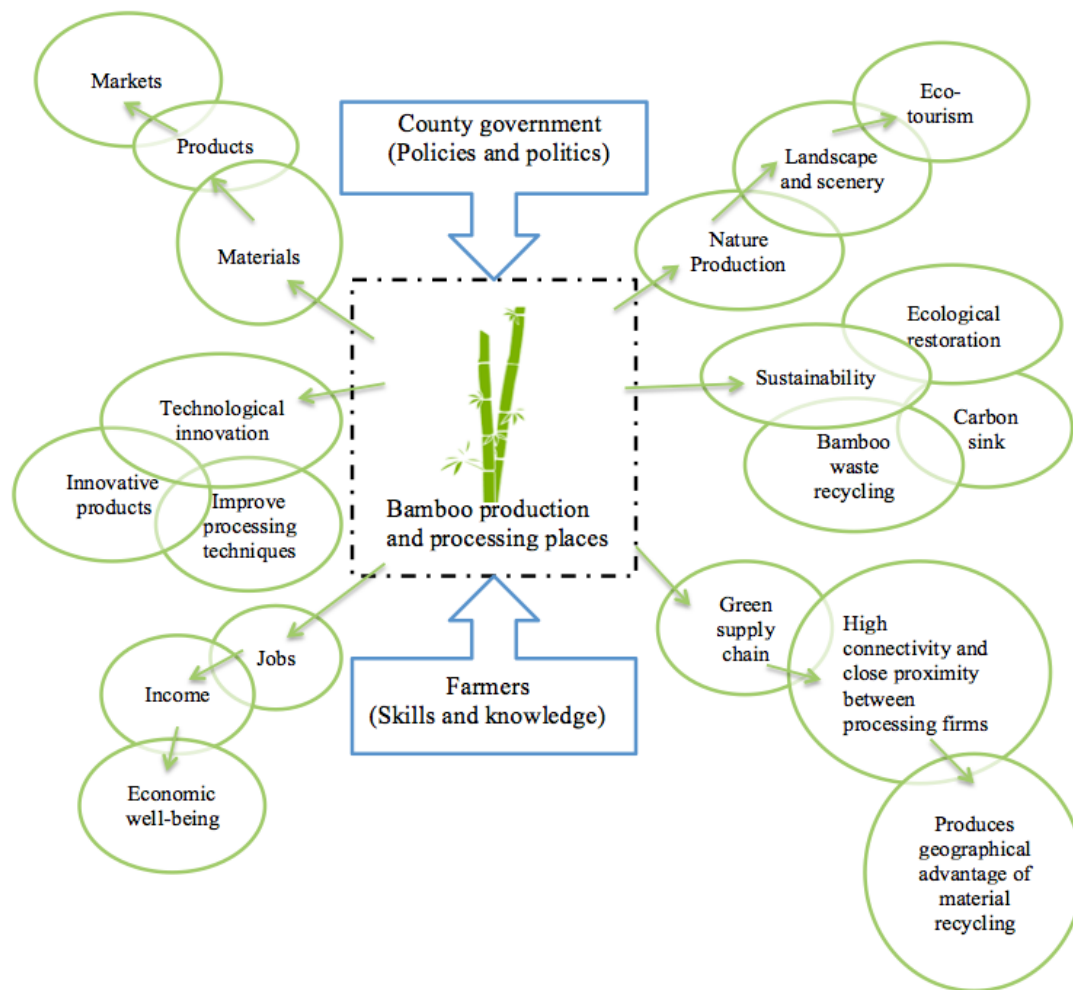
	Bamboo	Anji
Materiality - sustainability	<p>Fast growing, multi-purpose plant</p> <p>All parts of the plant (from roots to leaves can be used)</p> <p>Does not require inputs or treatment by pesticides or insecticides to grow</p> <p>Matures quickly</p>	<p>Rural county in Eastern China</p> <p>Subject to development pressure from neighbouring cities</p> <p>Prosperous rural area</p> <p>Dominant industrial activities based upon bamboo</p> <p>Tourism industry reinforces the</p>

		importance of bamboo
Meaning - sustainability	A 'natural' product Variety of end user markets Higher value added products (e.g. furniture) becoming ever more popular Increasingly promoted as a means of mitigating climate change (it absorbs carbon dioxide more efficient than other forests)	The 'home' of bamboo Nationally recognised for its model of rural sustainable development (e.g. winning awards) Increasingly dependent upon importing materials to satisfy local manufacturers and processors Represents itself to visitors as a bamboo county Bamboo products are accorded greater cultural value than those of other areas (partly as a result of its award winning status)
Governance	Supply chains Markets Regulation	Hierarchical, but increasingly decentralised Entrepreneurial development (by state and private actors) Prominence of environmental norms (e.g. curbing polluting activities, promotion of awards)

Source: Authors field research

In Figure 2 we illustrate how sets of institutions, actors, processes and activities cluster together to shape how bamboo and Anji are intertwined in producing a sustainable place and a sustainable material. Farmers are key as they are growing the raw material and have skills to harvest and process bamboo. As the Figure shows, though, farmers are only one set of actors involved in creating sustainability. For example, nature (dominated by bamboo), landscape (dominated by bamboo forests) and eco-tourism (there were estimated to be 4.5m tourists to Anji County in 2007 (China Daily, 2008)) that promotes a bamboo experience are nested together. Below, in Section 4, we explain further about the relationships between bamboo waste recycling and the geographical proximity of processing companies (in 2004 more than 40,000 people worked in this sector (Chen and Yan, 2009 p5) as we believe this is central to how bamboo is now being constructed as a sustainable material. The processing industry has proved to be a key job creator. In practice, of course, these relationships are more complex still, for instance, as markets and innovative products will be connected and so too markets and green supply chains but here we have wanted to illustrate the variety of bamboo related socio-economic and political activities.

Figure 2 Illustrative model for the co-construction of bamboo and place



Source: Authors field research

3. Data collection and methods

Mol (2006, p48) has highlighted that “in Chinese society informal social norms, rules and unwritten codes of conduct play a crucial part in structuring human action. These rules are firmly anchored in Chinese civil society, rather in the formal institutions of state and market” and these may play an important part in environmental reform but also in our approach to data collection. Most Chinese environmental research stresses the macro-scale to illustrate the economic

transition and institutional changes that have taken place at a national level. There is only limited research and empirical evidence to contextualize the local dimension of sustainable place building (Tilt, 2009; Wainwright, 2012). We have, therefore, sought to combine macro data with microanalyses (e.g. collecting county demographic and forestry statistics, official written reports and policy documents) to provide a more holistic picture by which to understand the Anji bamboo production industry. To achieve this, we conducted qualitative interviews and engaged with local actors (Tilt, 2010, p. 4) to understand their experiences and perceptions. By building a relationship with key individuals they were able to provide us with access to other actors. For example, local government officers arranged for visits to furniture and food processing companies. Key individuals were also able to make available data that might otherwise have been difficult to obtain.

The empirical base for the analysis in this article has been collected and built up over a period of time using a range of secondary and primary data collected through interviews and field visits by the authors from 2004 onwards. Data collection has also been carried out in the neighbouring county, Lin'an (which is to the South of Anji County), and is also noted for its bamboo growing. The time in the field has been used to establish links with government officials, private-sector actors and academics in neighbouring universities. We have conducted over 30 interviews with these key actors, visited firms and their leaders in the main economic sectors (including bamboo growers, process, traders) and had the opportunity to observe farmers and processors in action. We have also tested out the evidence and information given in policy and promotional secondary material with our informants. The relationships and trust that have developed over time, have enabled better access to officials and data. This has been particularly important as we have been keen to bring to light data on bamboo production and the operation of supply chains because it is central to the sense of sustainable place making that occurs in Anji.

Where information from interviews has been used in the text we have noted this but have not provided further information including that of the year in which the data was collected so that we can preserve the anonymity of interviewees.

4. The bamboo industry and place making in Anji

In this section we explore key aspects of Figure 2 to demonstrate how our model works in practice. In the section below we analyse how bamboo growing and processing take place; in 4.2 we explore how bamboo supply chains function and in section 4.3 we explain how waste management practices operate. The section ends with an exploration of the limits to constructing Anji as a sustainable place through its reliance on bamboo. Here we argue that the success of bamboo as a product is also creating challenges for how it can be grown, processed and marketed in a sustainable manner.

4.1 A sustainable model of development? Bamboo growing and processing in Anji

Part of the strategy adopted by Anji County government to develop the bamboo resource base depended on measuring the extent of bamboo growing. In 1978, the County government conducted a forestland survey to delineate the boundary of the mountain, clarify forest rights and responsibilities, and issue forestland certificates for farmers. This land survey was conducted in every single village in Anji. The survey recorded the size and boundary of the contracting plantation area, graded the soil, measured slope conditions, and counted the number of bamboo stems.

Shortly afterwards, from 1981 onwards, Anji County government implemented the “San Ding Policy” to activate the Household Responsibility System (HRS) in bamboo production. This contracted out bamboo forestland to individual farmers, consolidated the rural collectives’ right of ownership in bamboo forest lands, and offered the right of use and right to derive income to individual farmers. These

measures increased farmers' incentives to manage and invest in the bamboo forest plantation (Chan, 2015). For example, Mr. Lu greatly increased his investment in bamboo shoot cultivation after contracting lands from the rural collective in Dongwuli Village. In the decade since 1999, the productivity of Mr. Lu's bamboo culms³ increased from 1,500 to 2,475 per hectare; while bamboo shoot output increased from 10 kilogram to 1,500 kilogram per year per hectare (Chen and Yan, 2010, p2).

Moves to market reform have also affected how forestland is used and managed. There are now three major types of bamboo forest and ownership in Anji's bamboo forestlands: (1) State-owned forest, (2) Rural-collective owned forest, and (3) Privately-owned forest. Table 2 explains the different types of tenure and management arrangements for these three types of forest.

³ Culms are the bamboo stems that are cultivated.

Table 2 Forestland arrangements in Anji County

	Tenure arrangement	Types of lands	Decision making in production	Proportion of total forestlands
State-owned bamboo forest	From the 1990s, Anji County has contracted out these state owned forest spaces to forest workers and farmers to manage.	Lands owned by Central State government	County government	953 ha (1.4%)
Responsibility bamboo forest	The collective owns the land and resources. A shareholding management system is developed between individual farmers and collectives	Lands are contracted out from the rural collectives. Lands are allocated in a fragmented manner.	Individual farmers	14,860 ha (20.6%)
Collectively-owned bamboo forest	Township or village collectives operate the forest farms and non-forest farms.	The collectives own the bamboo forestland and resources.	Rural collective. The economic benefits earned from collective bamboo forest are used for the benefit of the villages (e.g. maintenance, construction, and other public purposes).	43,503 ha (78%)

Source: Lan and Chen, 2012; Chan 2015, pp149-150

In a further move to promote more intensive production Bamboo Plantation Supporting Policies were introduced. These emphasise state-driven investments to encourage bamboo farmers to utilise bamboo forestland to achieve high-yields, economies of scale, and high-efficiency bamboo cultivation. There are three major stages to achieve high productivity bamboo cultivation and these are summarised in Table 3. These stages in Table 3 are ones identified by Anji

County government officials as being important for them in the development of governance and policy for intensification and innovation.

Table 3 Stages to achieve high productivity of bamboo shoot cultivation

Stages of development	Policy incentives	Policy delivery
Stage 1 (1991-2003)	Providing subsidies to encourage producers to cultivate bamboo on hilly slopes	Bamboo farmers who planted bamboo on the hilly slopes would receive 1200–1500 Yuan subsidies from the Anji county government. Those farmers who adopted the “rehabilitation technology” to transform their low yielding bamboo could receive 450 Yuan per hectare. Those farmers who divided their forests into bamboo culms production and bamboo shoots production forest could receive a subsidy of 750 Yuan per hectare. Bamboo farmers who were willing to participate in Anji county government’s high yielding bamboo culms and shoots demonstration project would receive subsidy of 750–1000 Yuan per hectare.
Stage 2 (2004-2008)	Providing subsidies to producers to adopt high-yield bamboo practices	Those farmers who were willing to rehabilitate their existing bamboo forestland by replacing low-yielding bamboo seedlings with high-yielding ones received a subsidy of 1,200 Yuan per hectare. The County government provided 100,000 Yuan for producers who were dedicated to establishing a “bamboo demonstration unit”. Producers who were willing to adopt high yielding bamboo seedlings on more than 3.3 hectare would be subsidised with 3 000 Yuan per hectare.
Stage 3 (2009-2015)	Providing subsidies to develop ‘sophisticated Moso bamboo cultivation demonstration unit’	Anji County government has planned to build high-tech or sophisticated bamboo cultivation units as a “demonstration” model to farmers. Economies of scale and technological application are central. Bamboo producers who can extend their bamboo forest through economies of scale and using high technologies would be awarded 1.5 million Yuan per 6,700 hectares. In a demonstration bamboo cultivation unit, producers who are following the standardised, normative, and state-guided procedures would be awarded 50,000 Yuan. For instance, avoiding using chemical fertilizers, building water tanks and sprinkler systems are part of the normative bamboo demonstration’s unit’s standards and

are “constructing the [bamboo] ecology and strengthening the eco-economy” (Anji Forestry Bureau 2002, p12).

Source: Zhu et al, 2012; Chan, 2015

With land contracting and government support policies, the bamboo production area in Anji increased by 16.5% from 1988 to 2004 which generated more than 430 million Yuan.

4.2 Bamboo supply chains and sustainable place making

In recent discussions of sustainable place making (e.g. Horlings 2015), the importance of place in contributing to sustainable communities is recognised (see also Marsden and Farioli 2015). The valuing and use of local resources, the distinctiveness of local spaces matter. Horlings (2015, p258) argues that more emphasis needs to be given to “the crucial role of individual and collective cultural values in sustainable place-shaping processes.” The cultural dimension is undoubtedly important in Anji where bamboo provides a sense of belonging for local people, of what makes their place different from neighbouring areas (that may also grow bamboo, such as the neighbouring county of Lin'an). For many in Anji the day-to-day lived experience of working in or being part of a bamboo community gives meaning. Bamboo is a source of culture and has meanings for resource use and community development. For example, its higher tier government, Huzhou Municipal Government reports that Anji is the home of “bamboo culture which is modest and positive” (Huzhou Government 2013). Similarly a delegation from Ji'an noted in their report of a visit to Anji its “national historical and cultural resources ... the drama of ancient culture, ancient woods” (Ji'an Government, 2012). Cultural experiences help to define bamboo, to give the material meaning. As we have already indicated above, the meanings given to bamboo are dynamic and shaped by key actors, such as the County government and its approach to the development of bamboo as a resource. It is

the materiality of bamboo, and the way in which this too is constructed, that helps us to understand how sustainable place making can occur in Anji. The material and the place become ever more closely entwined in constructing a model of both. In the remainder of this section and the one that follows (4.3) we analyse how waste reduction has come to play an increasingly large part in the construction of bamboo as a sustainable material.

The nature of bamboo as a material and its markets make it a marker of sustainable materials – bamboo has multiple uses and the supply chain is constructed to maximise value from the material and at the end point produces little or no waste. By reviewing bamboo culms' production networks, we can analyse how material recycling is embedded in the bamboo culm-processing network, producing economic value and cultural meaning. A study of the mutual-aid efforts among producers and processors in the bamboo culms supply chain identified the availability of knowledge and information, technology, state policies, and organizational form in the successful promotion of material reduction and waste recycling (Van Koppen and Mol, 2009; Dicken, 2011; Yeung, 1994). Before the 1990s, the bamboo culm utilisation rate was less than 30%, which resulted in 70% of the bamboo culm becoming waste including saw dust, and the top and base parts of the bamboo culm. It meant that much waste material was visible alongside roads or in forests and around factories. To eliminate the waste part of the bamboo, processors burned the bamboo culm which resulted in serious local air and water pollution. Such wastefulness is not part of the imagery or practice of a sustainable material and would undermine any claims that local government might wish to make on Anji's sustainability. To begin to tackle the problem of waste, the County government encouraged the vertical integration of bamboo culm producers and processors so that supply could be better managed, promoted green processing and recycling technologies to reduce waste, and encouraged the conversion of low yielding bamboo plantations to high-yielding ones. This meant that the processors could contract lands to increase the quantity of bamboo materials that they needed for their processing activities. In

Table 4, we outline the factors that shape material recycling in the bamboo supply chain. The Table highlights how ecological modernisation features, such as technological innovation and environmental knowledge become increasingly diffused amongst bamboo growers, processors and the County government.

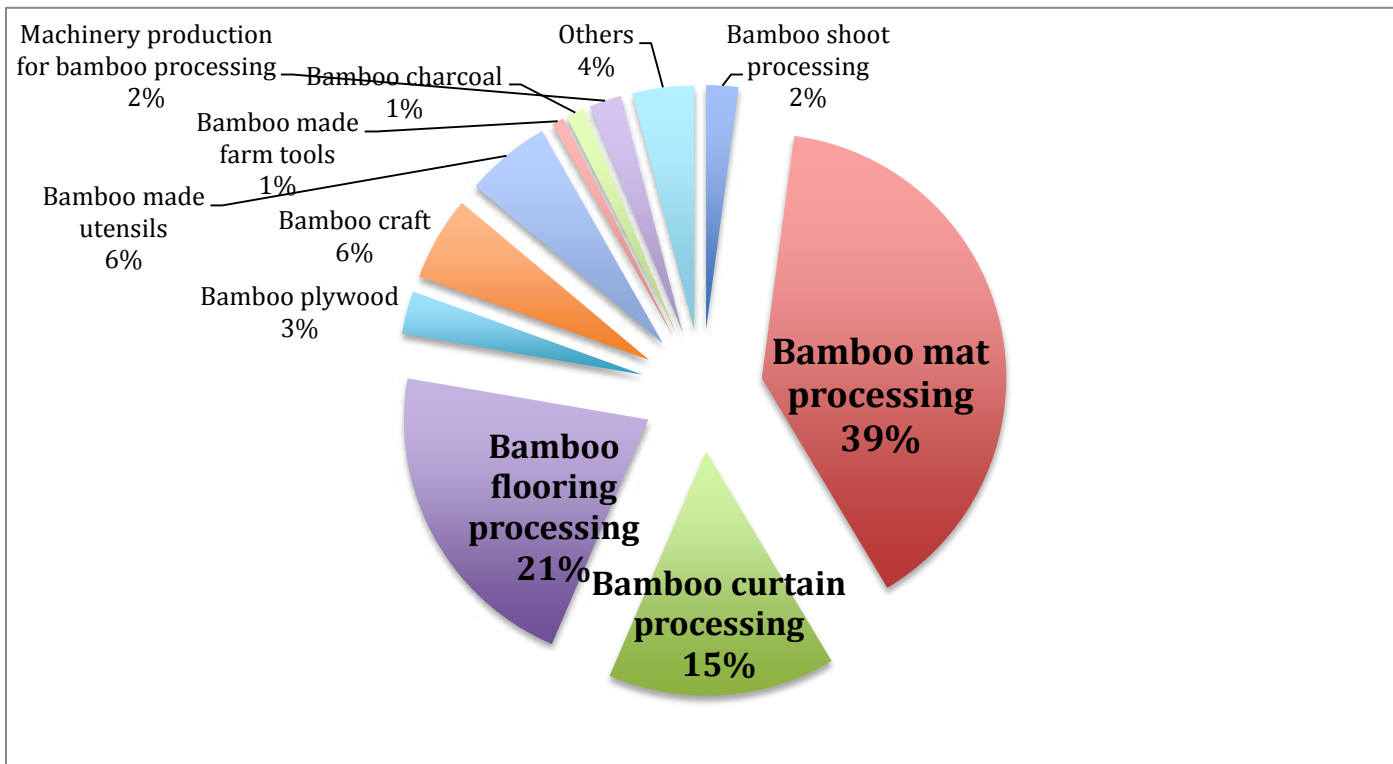
Table 4 Factors affecting the material recycling in bamboo culm processing networks

Availability of green knowledge and information	<ul style="list-style-type: none"> • Horizontal and vertical integration facilitates material utilisation knowledge exchange between firms • Material recycling is operated and co-ordinated among producers and processors • Local entrepreneurs are aware of the market values of bamboo materials and promote material reuse within production networks
Technological innovation	<ul style="list-style-type: none"> • Technological innovation produces opportunities to reuse materials
Financial investment to promote material reuse	<ul style="list-style-type: none"> • The County government maintains low environmental cost technologies (zero-waste processing) by providing funding for developing resource reuse, research and development, and resource recycling
Organizational forms influence the scale of environmental practices	<ul style="list-style-type: none"> • The close geographical proximity of bamboo culm processing firms facilitates material recycling. Material recycling is diffused to the whole bamboo culm processing industry and its going beyond single organizational forms and forms green network.
Environmental perceptions of processors	<ul style="list-style-type: none"> • Binary geographical linkages between the bamboo ecosystem and society. • Economic incentive drives local enterprises to reduce bamboo waste • County government promotes short-term remedial measures by farmers to control pesticide usage, pests and diseases

Source: with references to Dicken, 2011, Van Koppen and Mol, 2009, p306, Yeung, 1994

The reusing of bamboo material and the use of the whole plant has important economic and sustainability benefits. It has stimulated local processors and manufactures in the development of new products and markets: there are around 1,300 bamboo processing enterprises who process bamboo flooring, mats, curtains, carpets, crafts, chopsticks, charcoal, and daily utensils (Chen, 2009, p132; Chen and Yan, 2009, p1). These firms produce more than 5,000 types of bamboo related products annually (see Figure 3). From a sustainability perspective more efficient resource use and less waste by different types of bamboo processing factories has a positive impact on the local environment. According to the Zhu et al (2012, p1-3), the utilisation of one bamboo culm was only 23-30% in 1978, 30-50% in 1994 and 50-70% in the 2000s. Now, 95% of the whole bamboo culm can be fully utilised. The top-part of the bamboo (around 5-10%) will be used by chopstick and scaffolding factories; while bamboo curtain, mat and carpet factories will use the upper-middle part of the bamboo; flooring and furniture companies will use the lower-middle parts of the bamboo (around 40-50%). The base part of the bamboo (5-10%) will be used by bamboo charcoal factories.

Figure 3 Total Production Value of Bamboo Processing in Anji



Source: Zhu et al 2012

Bamboo mat processing is the single most valuable product (see Figure 3). It provides a good example of the way in which place and innovation can produce more sustainable outcomes. Anji's farmers have a long history of bamboo mat and curtain production. The vertical integration between bamboo production and processing firms provides a stable supply of raw materials for bamboo mat and carpet processing. Since the 1980s the production and place advantages of Anji bamboo matting has been further accentuated.

First, technological advancement in processing machinery, refining of processing techniques, and place-based processing services favour Anji's bamboo mat and curtain production (Chen and Xuan, 2006, p5). Second, the waste materials, such as off cuts or chippings, from the bamboo mat and curtain processing firms can become a resource input for bamboo charcoal, plywood, and composite board processing firms (Chen and Xuan, 2006, p5). So, rather than having to pay a fee to dispose of waste, chippings and off-cuts have a value as an input to another product. In 2006, the average market price of bamboo sawdust was around 150-200 Yuan per tonne (Chen, 2006). There is a close geographical proximity between bamboo mat, carpet and bamboo board processing firms that aids material reuse. Material recycling is increasingly diffused throughout the whole bamboo processing industry and goes beyond a single organizational form to become a 'zero-waste' processing network. Third, Anji County government promotes the exportation of bamboo mats and carpets as they attract preferential tax treatment in China. Fourth, bamboo mats and carpets are regarded as 'green products' whose value is heightened because they are produced in Anji and therefore reinforces Anji's environmental image.

4.3 The institutionalisation and standardisation of waste management practices

Being able to minimise waste is a key feature of a sustainable material. Waste can arise in any of the three major layers of the bamboo processing supply chain: (1) bamboo farming (e.g. poor harvesting techniques), (2) primary processing factories (and waste here might be dust, off-cuts or surplus materials), and (3) secondary manufacture. Bamboo farmers grow bamboo and sell the bamboo culms to primary processing factories. Then the primary processors process the bamboo culm into different semi-finished products to fit with different secondary manufacturers' needs. Each secondary manufacturer will buy semi-finished products from different primary processors and process it into different final goods for sale in the market (Smith and Mestre, 2010).

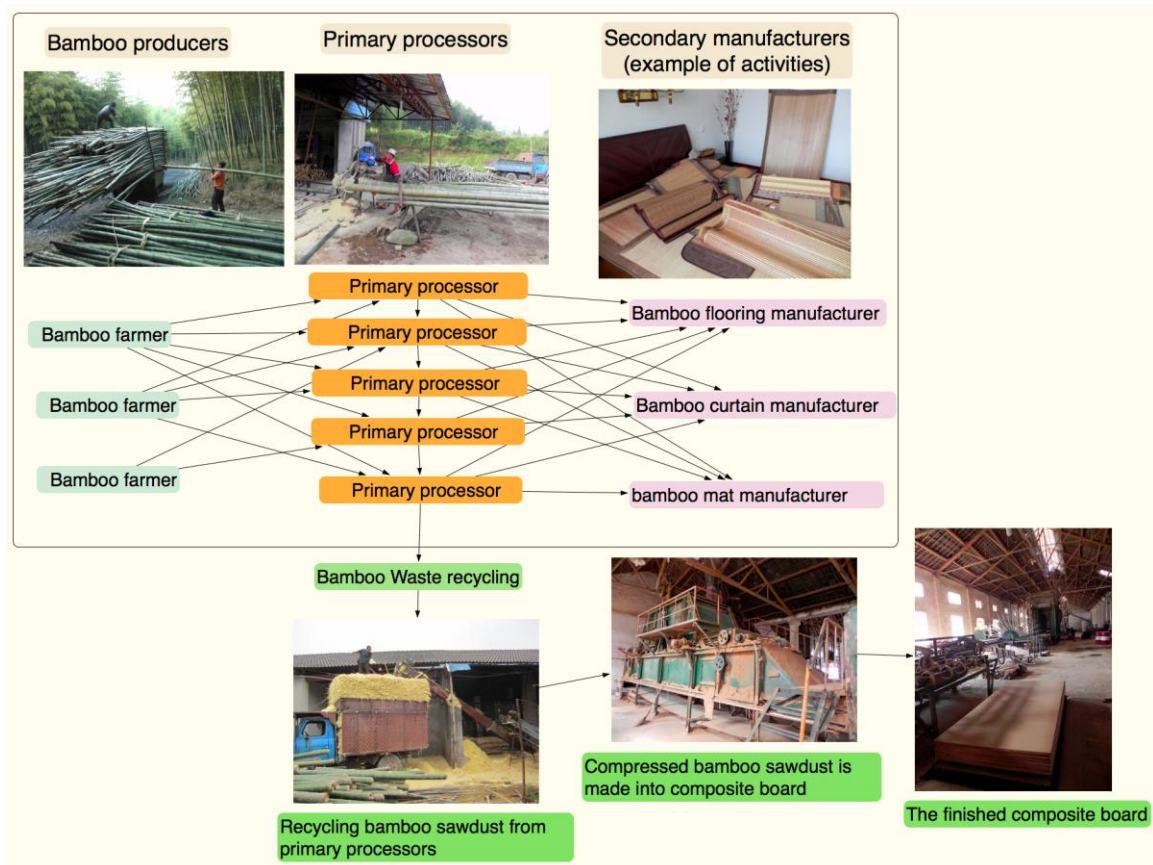
In the material below we have looked in detail at data from the Anji Forestry Bureau (2006) to compare bamboo mat, curtain and flooring processing firms' waste management. As we shall see, the data shows that waste generated from processing is limited, demonstrating a high level of material efficiency. For instance, the bamboo mat processing firm Zhejiang Anji Shuang Yang Bamboo Processing Firm, needs 24.5 bamboo culms to produce 50 kilogram of bamboo mat with a material wastage rate of 10%. Another efficient company that produces bamboo curtains is Anji Xian Zhang Cun Zhang Jian Bamboo and Wood Production Plant. It used 27.5 of bamboo culms to produce 50 kg of bamboo curtain and only 5% of the material is wasted. A third example of a company that minimizes waste is the Yangzi Bamboo Products Co. Ltd., which used 21 bamboo culms to produce 50 gram of bamboo plywood and flooring and had a wastage rate of 10%. By keeping waste to 10% or less bamboo mat, curtain and flooring primary processors play a crucial role in increasing material utilisation. According to Smith and Mestre (2010, p.23),

“The primary processing businesses do not need to make finished goods from all the bamboo they are able to operate profitably at a small scale with low capital investment. So they are easier to set-up and operate profitably... [The] secondary manufacturing businesses can drive down

their unit costs of raw material as they only buy the precise part of the bamboo culm they need. They do not have to find alternative markets for large amounts of unwanted processing waste or invest extra capital in additional product lines to achieve the efficiencies within their own business...In Anji, primary processors emerged only after there were already a large number of competing manufacturing businesses. Primary processors were able to offer immediate savings to these businesses due to their greater efficiency and so they were able to quickly restructure the industry to everyone's benefit. Importantly, a good mix of competing secondary manufacturers already existed."

The operation of the bamboo supply chain is shown in Figure 4. The geographical proximity of firms and the key role played by local government ensures that waste management is promoted and that resource efficiency has an economic rationale.

Figure 4 The operation of the Anji bamboo supply chain



Source: Zhu et al., 2012; Chan, 2015

Greater material efficiency for processing firms in Anji has positive economic and environmental benefits. According to Zhu (2006), a major environmental problem had been the sawdust that used to be piled up in front of the factories, riversides and roadsides. Now, though, through the recycling of bamboo waste sawdust is no longer an environmental problem as it is utilised in the making of bamboo fibre board, granules, and charcoal bricks, which are some of the most profitable products made in Anji. In Anji, there are five bamboo fibreboard production companies which can convert 160,000 tonnes of bamboo sawdust into 8,000 cubic meters of middle-density fibre board (Chen, 2006). Additionally, the edges which are cut off from bamboo flooring panels can be used to produce laminated furniture, tea sets, flower holders, handicrafts, and gift boxes (Chen, 2006).

4.4 Material efficiency, sufficiency and scarcity: challenges for sustainability at the local level

The very success of Anji as a bamboo producer and processor has set up a series of challenges as to how this can be maintained and how Anji can continue to promote both bamboo and itself as sustainable. These challenges are: overcoming local production shortages, over-dependence on bamboo in the local economy, and over intensification of the production of bamboo.

The scale of processing in Anji and the demand for products that have an Anji label far outstrips local bamboo production. Even though Anji is the major bamboo culm producing county in China with an annual production of 20bn culms (equivalent to 330,000 tonnes of bamboo) (Zhu, et al 2012, p2) it falls far short of demand. For instance, in 2008 the consumption of bamboo material by industry was about 120bn culms, so some 80% of materials processed in Anji had to be imported from elsewhere in China. The scale of the material resource flows thus provides a challenge to the promotion of an eco-economy, at least like one envisaged by Marsden and Farioli (2015). As Zhu et al (2012, p2) note “To solve the raw materials crunch, the local government has attached great importance to optimum material utilization, aimed at making the maximum out of

existing bamboo resources for better economic, environmental and social effects.”

The scale of bamboo imports into Anji and their role in maintaining Anji as a supplier of high quality bamboo products has meant that local government has played a role in ensuring continuity of supplies (Chan and Yan, 2012). A principal move has been to contract forest areas in other bamboo producing areas such as Fujian, Jianxi, Hunan and Anhui Provinces. By the end of 2004 about 20,000 ha of forestland had been contracted and in the following decade that figure will have further increased. Typically when contracting forestland local bamboo growers will also be required to follow the Anji model of intensive production (e.g. greater use of fertiliser, winter shooting) to increase their output. Another option is for both larger and smaller enterprises to invest in processing facilities in bamboo growing areas outside of Anji e.g. Minyu Flooring Co Ltd opened a factory in Fujian Province. The semi-processed bamboo products are then sent back to Anji for finishing into products. In this way Anji solves its material shortage, extracts added value from bamboo products and continues to nurture its reputation as the home of bamboo and a sustainable place. Anji's entrepreneurs and local government are now bound in much more complex ways to other bamboo growing areas. The relationships are typically portrayed as ones of partnership or helping less developed bamboo areas to develop along a similar pathway to Anji but cannot disguise that these are also exploitative of resources to fuel the Anji economy.

It is difficult to overstate the importance of bamboo to the Anji economy, sense of self-identity and contribution to a model of rural development. For instance, Anji's total population is about 450,000 people of whom over 350,000 live in rural areas. There are about 120,000 households. Nearly 50,000 households are engaged in bamboo cultivation with about 35,000 farmers engaged in product processing and about 3000 households involved in product sales (Zhu 2006, p10). Nearly 60% of Anji's income is directly generated by the bamboo sector.

Such dependence on a single material is though risky. As a result, the bamboo industry has sought to secure supplies from more distant locations and to intensify production at home.

The demand for bamboo and policy incentives has encouraged farmers to extend and intensify bamboo forests. Anji is a hilly, forested county and over 50% of its forestland is bamboo (nearly 70,000 ha). Of the bamboo forest about 80% is Moso bamboo and so the county is now dominated by a mono species which makes it more vulnerable to disease. In addition, farmers now use more fertiliser and pesticides to increase output. This is having a damaging effect on local water courses. For instance, Guo et al. (2011, p593) and Huang et al. (2001, p.7) argue that farmers tend to depend on pesticides usage to eliminate the epidemic pests in Zhejiang provinces; and in some areas the level of pesticides usage was higher than the country-allowed dosages.

5 Conclusions: Evaluation of sustainable spaces and sustainable spaces in Anji

In the paper, we have argued that sustainable place making needs to pay attention to both supply chains and to communities, especially in Anji where the identification with bamboo is so strong and helps to define a local model of sustainable development. The administrative capacity of local government in modernizing the bamboo industry is of major importance (Zhu, 2006; Liu and Edmunds, 2003). Anji County government acts as an entrepreneur to provide financial and technical support to the bamboo industry. The values of nature from the government to bamboo producers are anthropocentric and manipulative towards nature. Bamboo nature is treated as an economic project; it is managed and manipulated to increase the productivity of the bamboo industry. There are insufficient ecological practices (e.g. crop diversity, fallowing, and pollution-free cultivation) to maintain the balance between conserving the carrying capacity and maximizing the utility of the bamboo ecosystem. Local bamboo producers

depend heavily on pesticides usages to stabilize the vulnerable bamboo ecosystem.

In understanding both the authority of Anji County government and its openness it has to be recognized that there are limited channels for producers to contribute their knowledge and voices in the bamboo production system. The emphasis is on increasing intensification whilst seeking also to promote ecological benefits. According to the Global Bamboo Resources Assessment Report – China Country report (GBARA, 2005, p4),

“All those [bamboo] research projects were production-oriented, and had given active guidance to enterprises at the grassroots level. The research results have been used in forest renovation, the second-season shooting, processing of bamboo ply boards and the development of bamboo leaf flavone, which drive the bamboo industry’s rapid advancement.”

New regulations and standards for forest management, bamboo production and processing all suggest moves towards the ecological modernisation of production (Mol 2006). However, the regulations tend to be weakly enforced. There is also a reluctance to recognise the adverse consequences that arise when increasing production is dependent on monoculture and toxic-pesticides usage. Overall, ecological progress in the bamboo industry is weak as the industry pays insufficient attention to problems arising from its production emphasis.

Nature is used to generate economic value and to help govern the rural population. Farmers will remain in rural areas whilst they can be confident of high and increasing standards of living. Bamboo is the natural resource that has become the basis of prosperity in Anji. So, Anji’s sustainable development model depends on a bamboo industry that is reliant on high inputs of energy, pesticides, and fertiliser to provide a resource base for production, and processing. Meanwhile, tourism and the use of forestland as a carbon sink depend on the visibility of bamboo. From the perspective of local government and local farmers, the development model is dominant and alternative models that could

incorporate more ecological visions cannot be easily envisaged. As a result, there is a continual and unquestioning reproduction of current economic and social relations. Visually and economically the landscape is vibrant and underlying environmental problems are marginalised.

Bamboo is continually promoted within Anji and beyond as a sustainable material. Anji has long been famous as a home of bamboo and continues to enhance that reputation today. The place and the material become synonymous, and can reinforce ideas of sustainability. Local constructions of sustainability are not, though, driven by a sense of environmental protection but rather by economic values. Over time we expect the contradictions between production, processing and place to become more apparent and to make the forming of a local model of sustainability more challenging. The tensions between green practices and ideas run into traditional development interests. Anji is constructed as 'green', sustainable place but beneath the surface it is bedeviled by contradictions. For example, the government will highlight the positive side of bamboo to absorb carbon but will be reluctant to recognize that it will rely upon monoculture. Without the continuing exploitation of bamboo as a resource Anji will decline as a place that is associated with a green and sustainable image; and yet its reliance upon bamboo results in supply chains that become geographically longer, and rely upon more intensive production and the exploitation of nature.

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